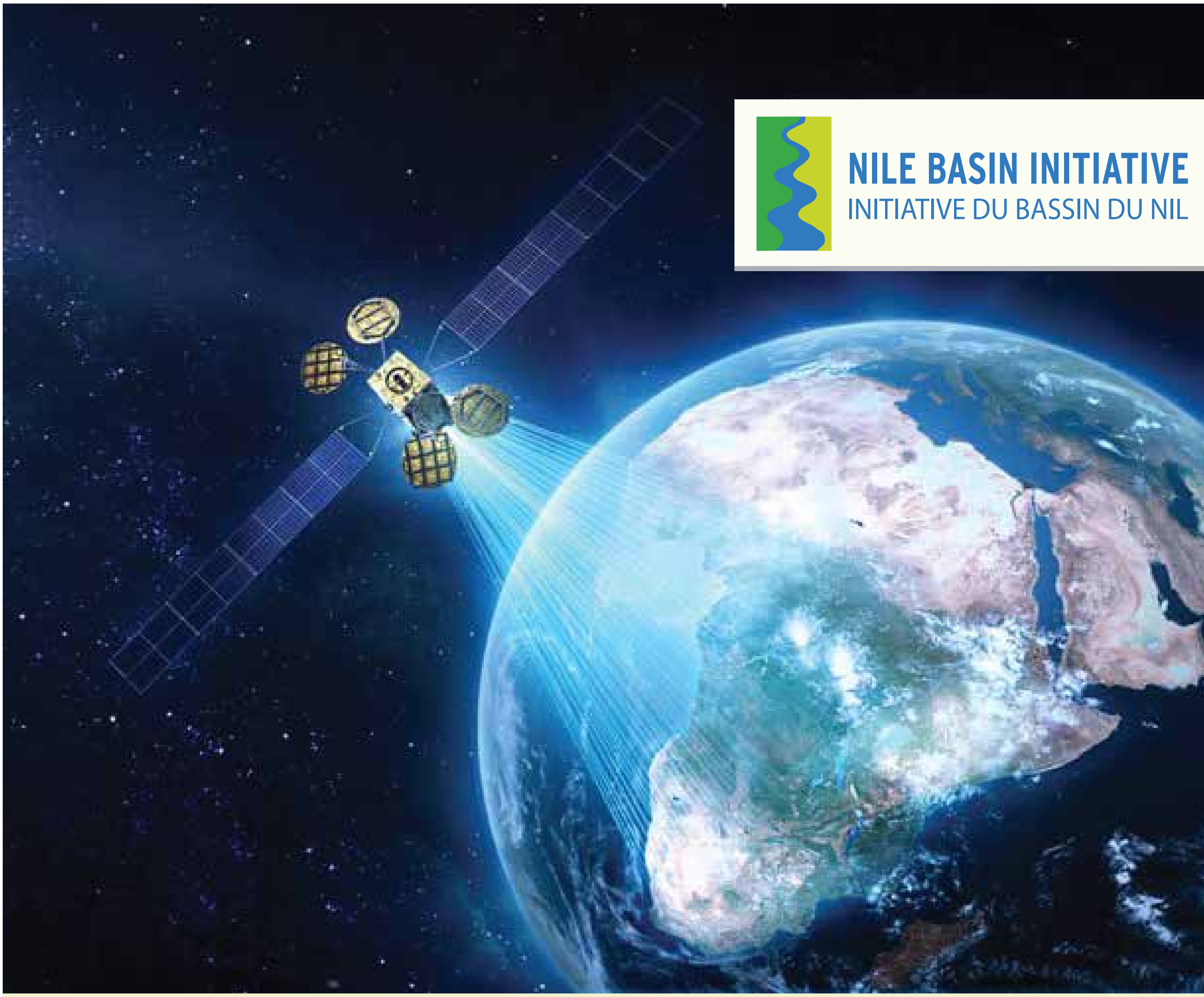

NILE BASIN INITIATIVE
INITIATIVE DU BASSIN DU NIL

April - June 2018

MONITORING THE NILE BASIN USING SATELLITE OBSERVATIONS

Highlights

- Satellite observations show that rainfall received in April to June 2018 was higher than the long term average in all the subbasins.
- Rainfall excess maps (P-E) and soil moisture maps for April to June show high values in the equatorial lakes region compared to the eastern Nile region. P-E gives an indication of available water for runoff.
- Lake Kyoga and Lake Tana show a slight increase in the water levels from April to June while Lake Victoria shows a reduction in the water levels.

MONITORING THE NILE BASIN USING SATELLITE OBSERVATIONS

April - June 2018

The Nile Basin Initiative (NBI) is an intergovernmental partnership of ten Nile riparian countries that is seeking to manage and develop the common Nile water resources in a cooperative manner and promote regional peace and security.

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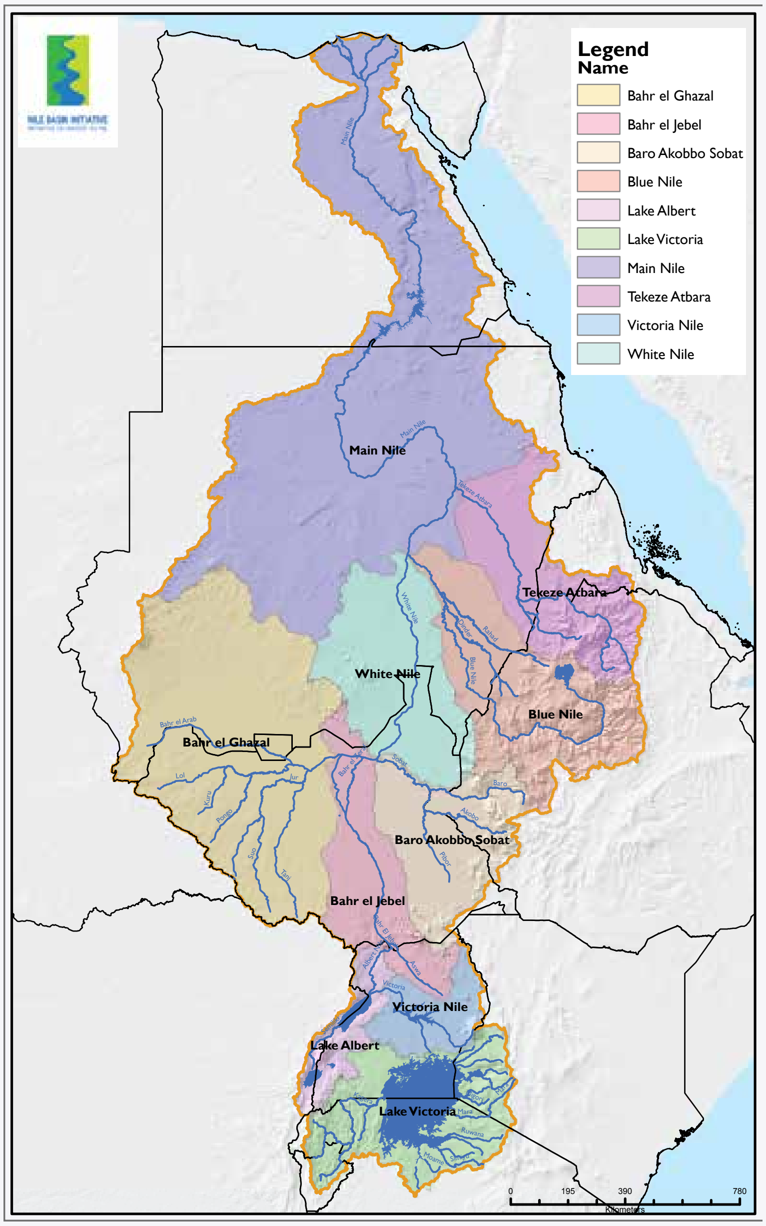
INTRODUCTION



Major Sub-Basins of the Nile Basin.

The River Nile Basin covers about 3,176,541 square kilometers, which represents about ten percent of Africa's land mass area. The river presents an array of opportunities for a sustainable future. This can only be realized if riparian countries can jointly plan, manage and develop the shared resources in a coordinated manner. Since time immemorial, the river plays a central role in human settlement and in the development of a rich diversity of cultures and livelihoods. The basin includes world class environmental assets such as River Nile being the longest river in the world, Lake Victoria being the second largest fresh water lake by surface area; and the Sudd wetlands in South Sudan being one of the largest in Africa.

The Nile basin region is a land of increasing population and rapidly changing landuse patterns; changes that have profound local, regional and global environmental significance. In addition, the region experiences diverse climatic conditions which result in changes in seasonal and annual flows of the river. Monitoring of such processes is a pre-requisite to sound water resources management.

It was with this realization that the Nile Basin countries established the all-inclusive Nile Basin Initiative (NBI) on February 22, 1999 with the shared vision objective: 'To achieve sustainable social economic development through the equitable utilization of, and benefit from, the common Nile Basin water resources.

According to its 10 year Strategy (2017-2027), NBI aims at strengthening evidence-based transboundary water resources planning and management through improved monitoring of the Basin using satellite observations.

The NBI in collaboration with its member states has designed a regional Hydro-Met monitoring system to enhance basin monitoring. In addition, use of satellite data has been identified as one way of supplementing the existing monitoring system.

This Basin Monitoring bulletin aims at providing a shared understanding of patterns of some of the water cycle components in our changing environment based on satellite data. Estimates of water cycle parameters provide insights on available opportunities for water use, water conservation and thereby enhance water use efficiencies.

This issue provides an analysis of Rainfall, Actual Evapotranspiration in the 10 major sub-basins, and an analysis of Water levels in some lakes from April to June 2018 in addition to the seasonal analysis of the March- April - May (MAM) seasonal anomaly over the Nile basin.

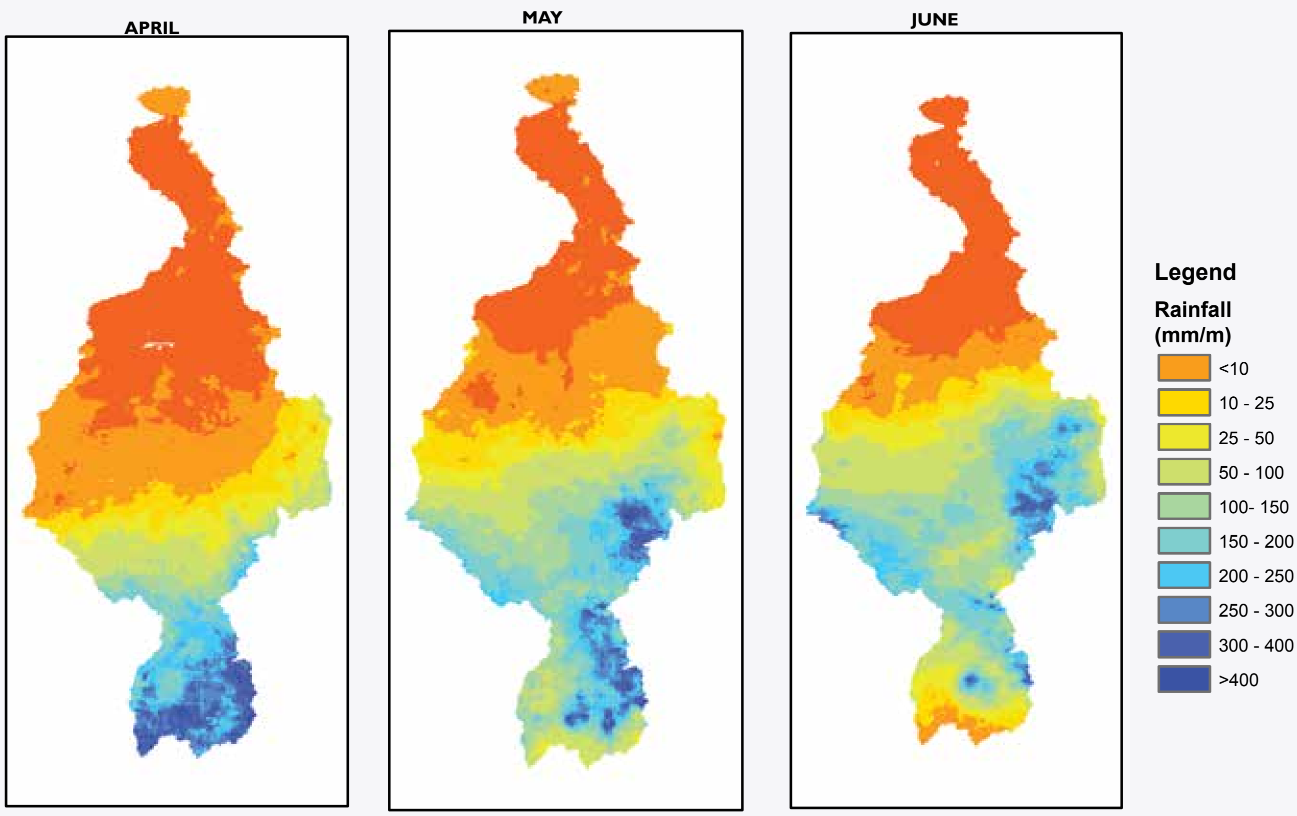
VARIABILITY OF RAINFALL IN THE NILE BASIN

Rainfall in the Sub-basins of the Nile Basin has been estimated using CHIRPS v2.0. Climate Hazards Group InfraRed Precipitation with Station data (CHIRPS) is a 30+ year quasi-global rainfall dataset. Spanning 50°S-50°N (and all longitudes), starting in 1981 to near-present, CHIRPS incorporates 0.05° resolution satellite imagery with in-situ station data to create gridded rainfall time series for trend analysis and seasonal drought monitoring.

By combining high resolution (0.05°) rainfall mean fields with current satellite-derived rainfall estimates, the Climate Hazards Group InfraRed Precipitation with Stations (CHIRPS) estimates provide daily, pentadal(5-day), dekadal (10-day), and monthly precipitation fields suitable for crop monitoring and drought monitoring.

Overall, rainfall estimates indicate a wide spatial and temporal rainfall variability in the basin. Minimum rainfall is seen in the arid areas in the northern part of the basin and the maximum rainfall estimates are observed in the equatorial lakes region in the areas around Lake Victoria and the Ethiopian Highlands. Monthly distribution of rainfall over the basin is characterized by monomodal rainfall patterns (June-July-August (JJA)) in the Ethiopian plateau especially in the Blue Nile and Tekeze subbasins and bimodal rainfall pattern (March-April- May (MAM) and September- October-November (SON) in the equatorial lakes region especially in the Lake Victoria, Lake Albert, Victoria Nile sub-basins.

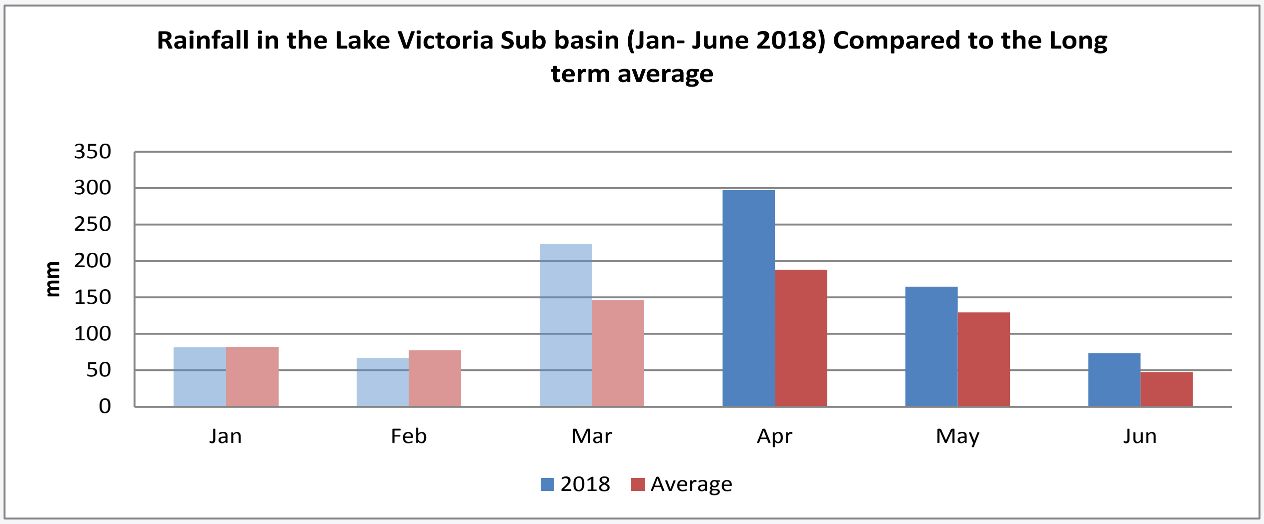
During 2018, from April to June, rainfall was observed in the Nile Equatorial Lakes subbasins and less or no rainfall was detected in the Eastern Nile Subbasins as seen in the maps below. A full analysis for each of the sub basins is given in this quarterly bulletin.



Monthly Rainfall (mm) April - June 2018 , CHIRPS v 2.0

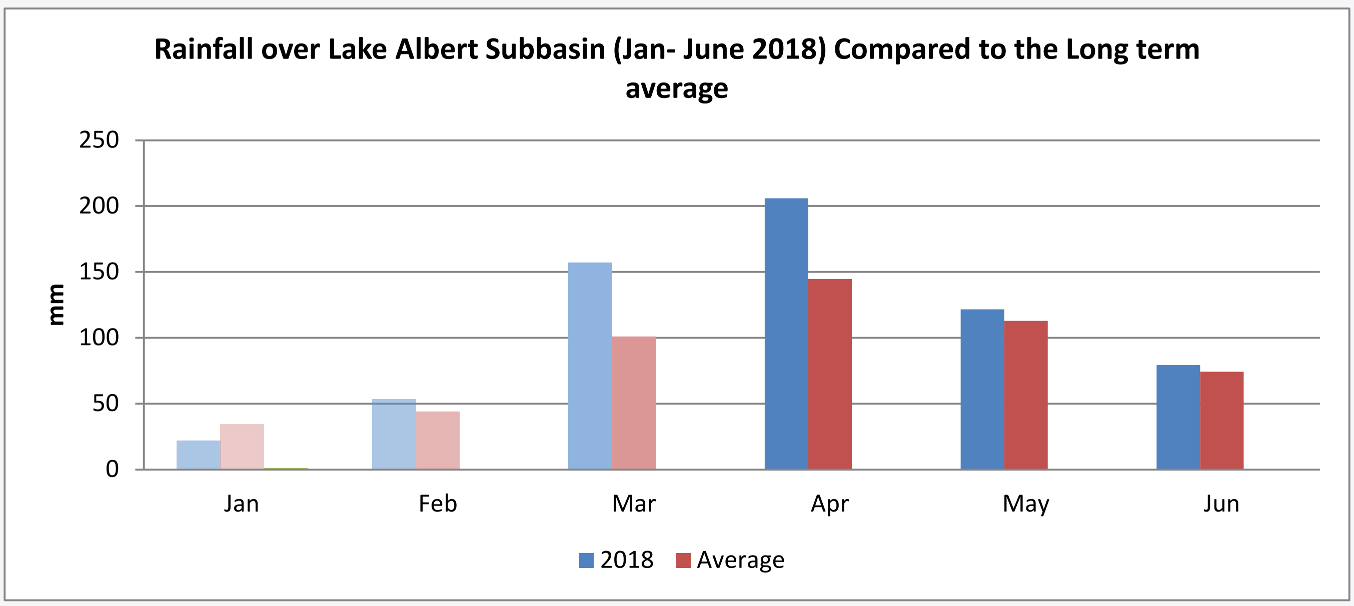
RAINFALL OVER LAKE VICTORIA SUBBASIN

The Lake Victoria subbasin normally experiences a bimodal rainfall pattern with two rain seasons MAM and SOND. Monthly rainfall estimated by CHIRPS v2.0 from January to June in 2018 shows a similar pattern of increasing rainfall during the MAM rainfall season. The estimated was 58% above the longterm average with the highest rainfall recorded during April of 300mm as shown in the chart below.



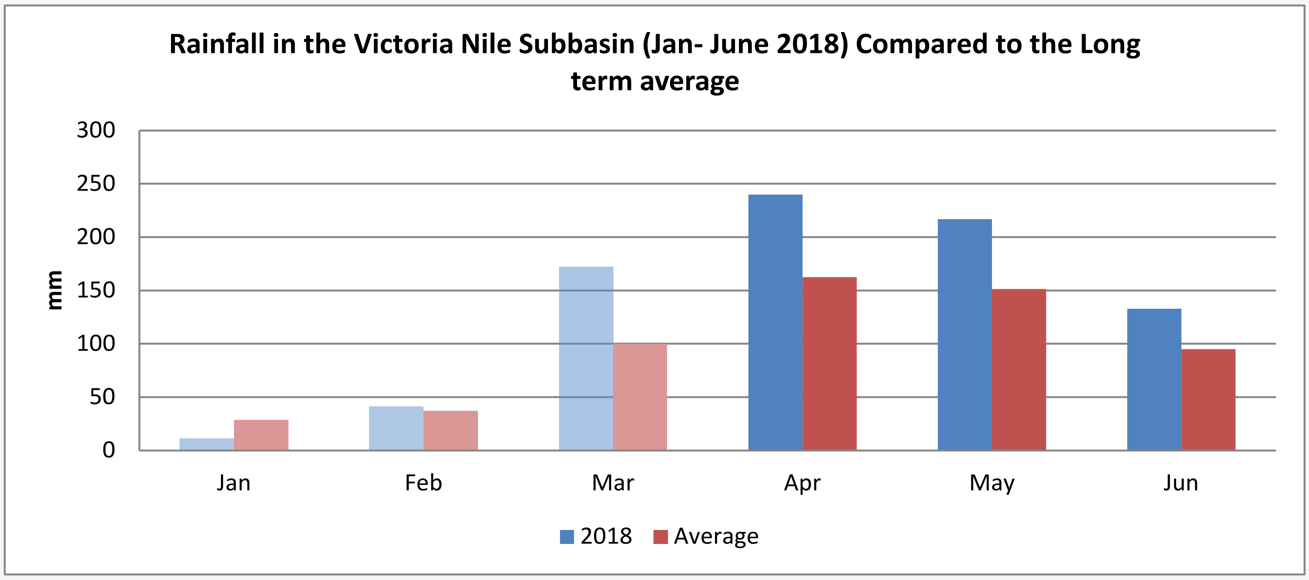
RAINFALL OVER LAKE ALBERT SUBBASIN

Lake Albert subbasin normally experiences a bimodal rainfall with two rain seasons in MAM and SOND. In 2018, CHIPRS v2.0 estimated rainfall shows the same pattern with increasing rainfall during the MAM rainfall season. The estimated rainfall shows an increase above the longterm average by 42% with the highest rainfall recorded during April of 205 mm as shown in the chart below.



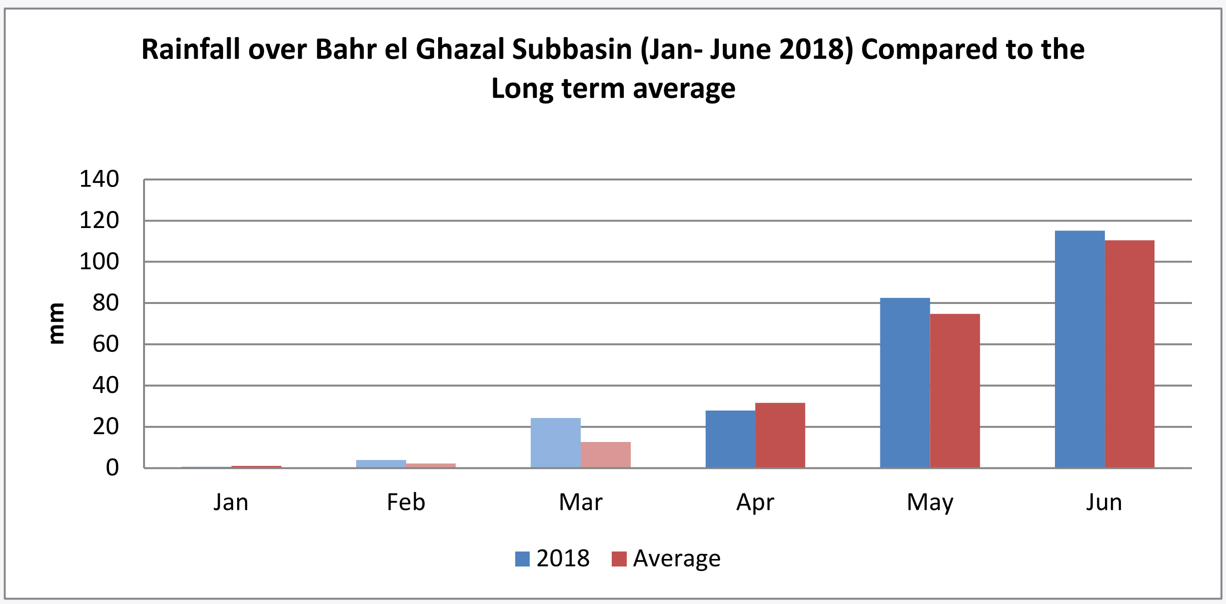
RAINFALL OVER VICTORIA NILE SUBBASIN

The Victoria Nile subbasin normally experiences bimodal rainfall seasons of MAM and SOND like the other Nile Lakes Equatorial sub basins. In 2018, CHIRPS v2.0 estimated rainfall shows the same pattern with increasing rainfall during the MAM rainfall season. The estimated rainfall shows an increase by 47% above the longterm average with the highest rainfall recorded during April of 240mm as shown in the chart below



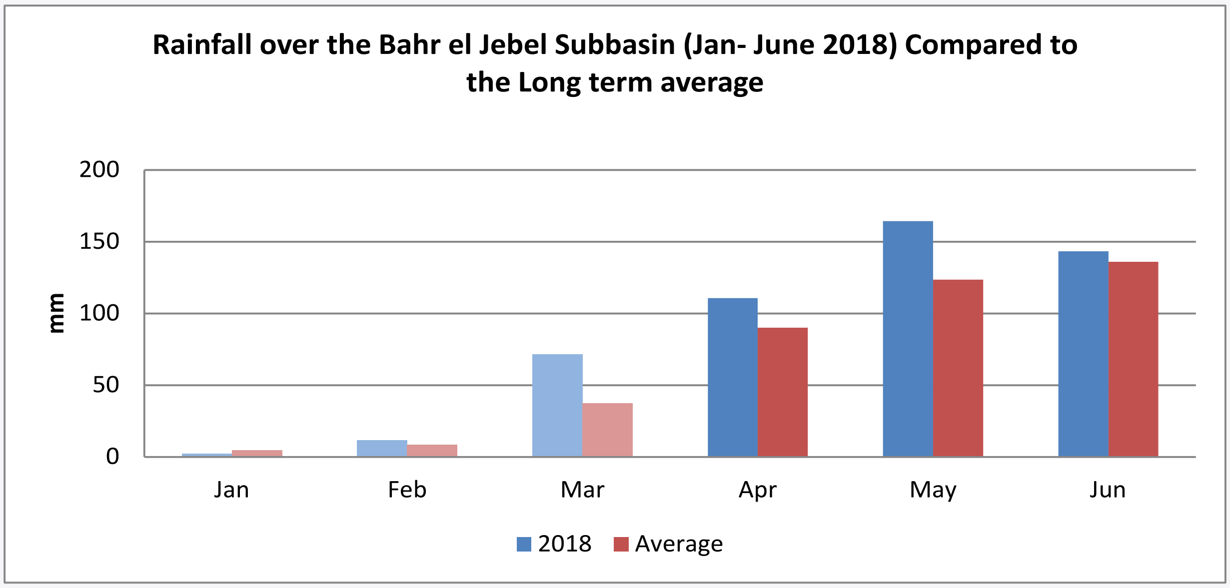
RAINFALL OVER BAHR EL GHAZAL SUBBASIN

Bahr el Ghazal sub-basin shifts from a bimodal rainfall pattern to a monomodal rainfall pattern. However, the northern part of the basin which lies in Sudan is dryer than the southern part of the basin in South Sudan. In 2018, April to June, CHIRPS v2.0 shows a gradual increase as the subbasin approaches the rain season with the highest rainfall recorded in June of 118mm which is slightly higher than the long term average by 4% as shown in the chart below



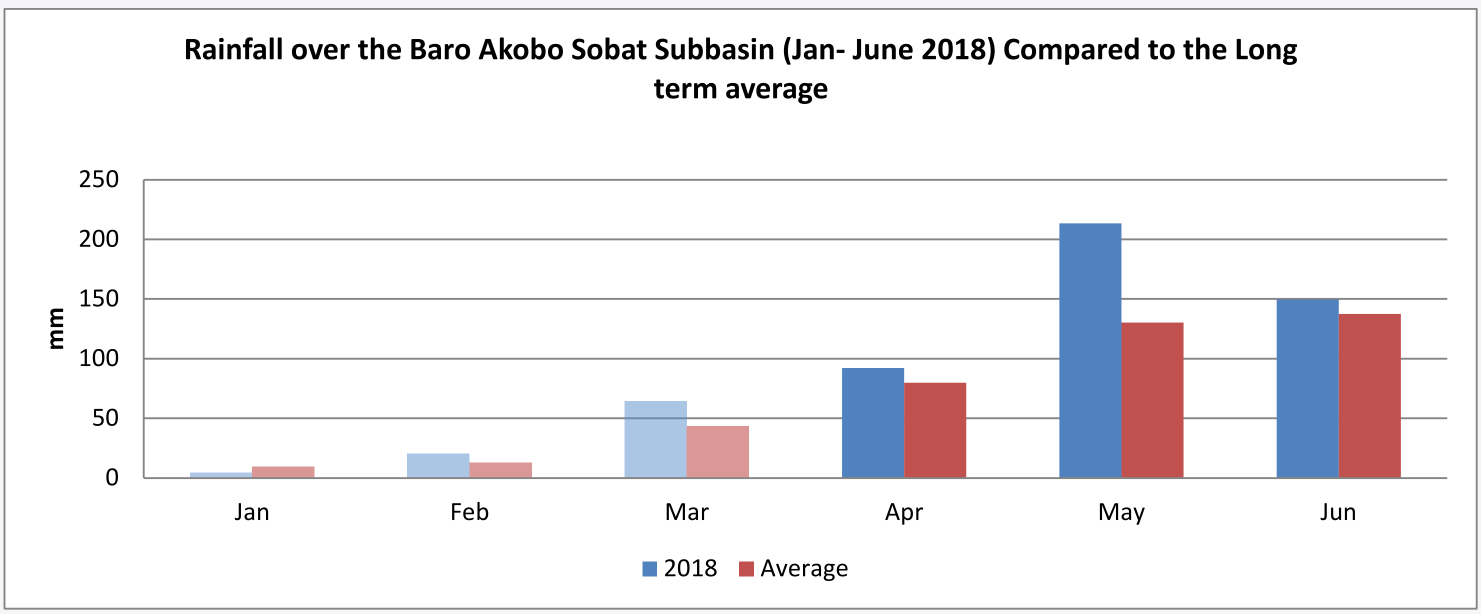
RAINFALL OVER BAHR EL JEBEL SUBBASIN

Bahr el Jebel sub-basin shifts from a bimodal rainfall pattern to a monomodal rainfall pattern. Monthly estimated rainfall from April to June of 2018 shows a gradual increase with the highest record in May of 164mm higher by 33% than the long term avaerge as shown in the chart below.



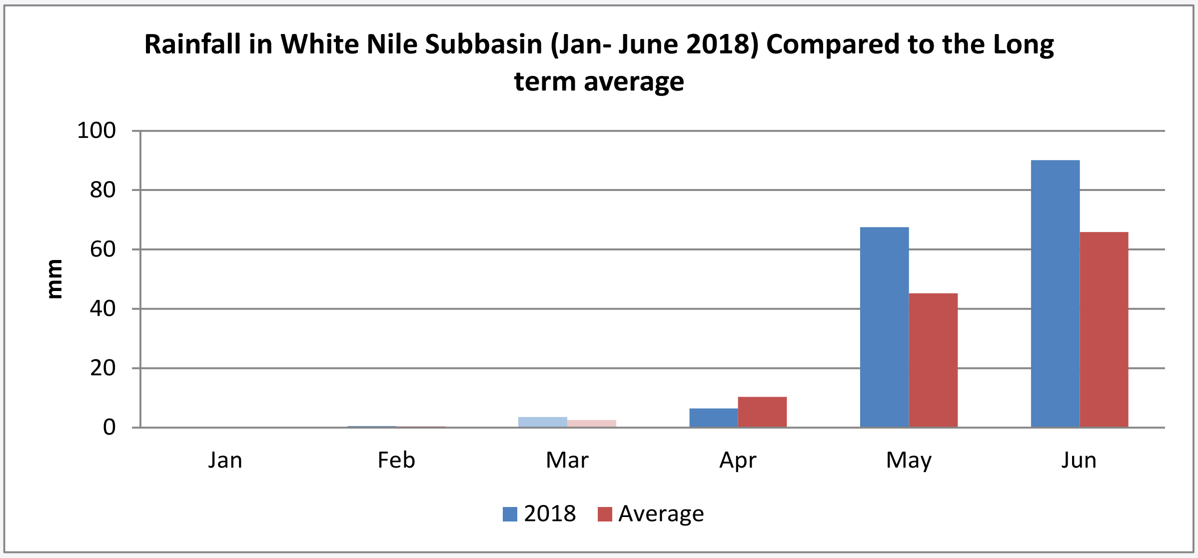
RAINFALL OVER BARO AKOBO SOBAT SUBBASIN

The Baro Akobo Sobat subbasin normally experiences a monomodal wet season between May – October. Monthly rainfall estimated by CHIRPS v2.0 from April to June 2018 shows gradual increase as the rain season approaches in higher amounts compared to the long term average. Highest recorded rainfall between April to June was 210 mm (63% increase) in the month of May as shown in the chart below.



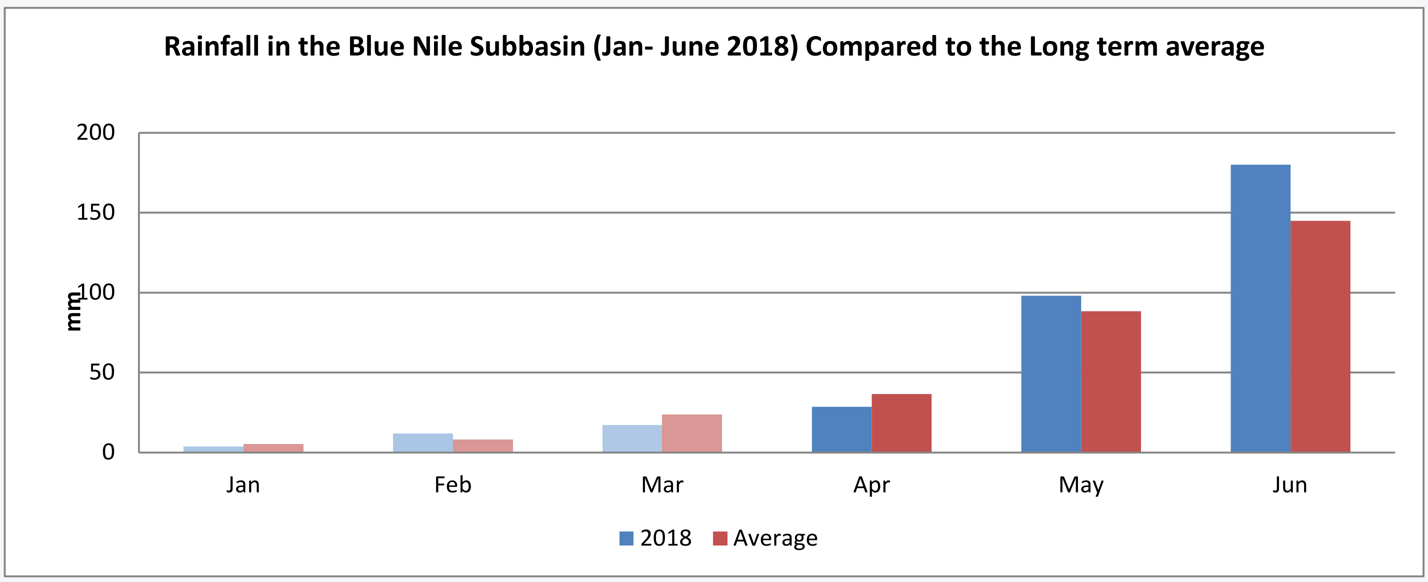
RAINFALL OVER WHITE NILE SUBBASIN

The White Nile subbasin rainfall normally reduces gradually northward with a monomodal pattern from May to October. This basin covers parts of north-eastern South Sudan, a small part of south western Ethiopia and the south part of Sudan.   In 2018, CHIRPS V2.0 shows a similar pattern of monthly rainfall from April to June as the subbasi begins to experiance the start of the rain season. The subbasin recieved more rainfall in May and June compared to the long term average by 49% and 36% respectively as shown in the chart below.



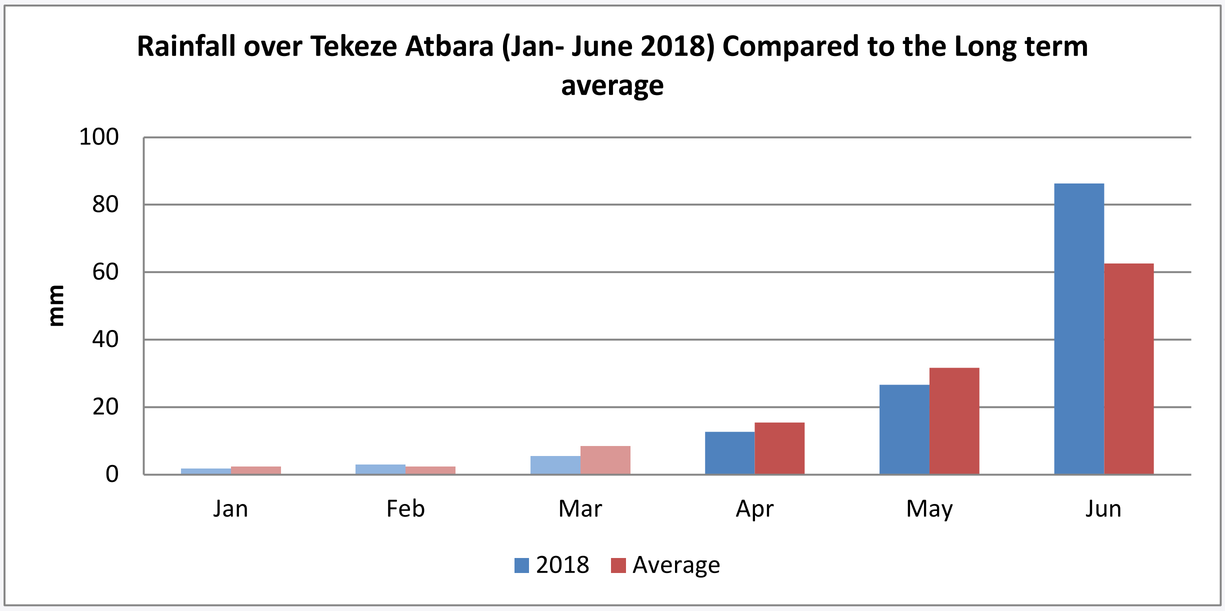
RAINFALL OVER BLUE NILE SUBBASIN

The Blue Nile Subbasin is shared between Sudan and Ethiopia and experieinces monomodal rainfall from May to October. In 2018, CHIRPS V2.0 shows a similar pattern of monthly rainfall from April to June as the subbasi begins to experiance the start of the rain season as shown in the chart below. Highest recorded rainfall between April to June was 180mm in the month of June which is higher than the long term average by 24%.



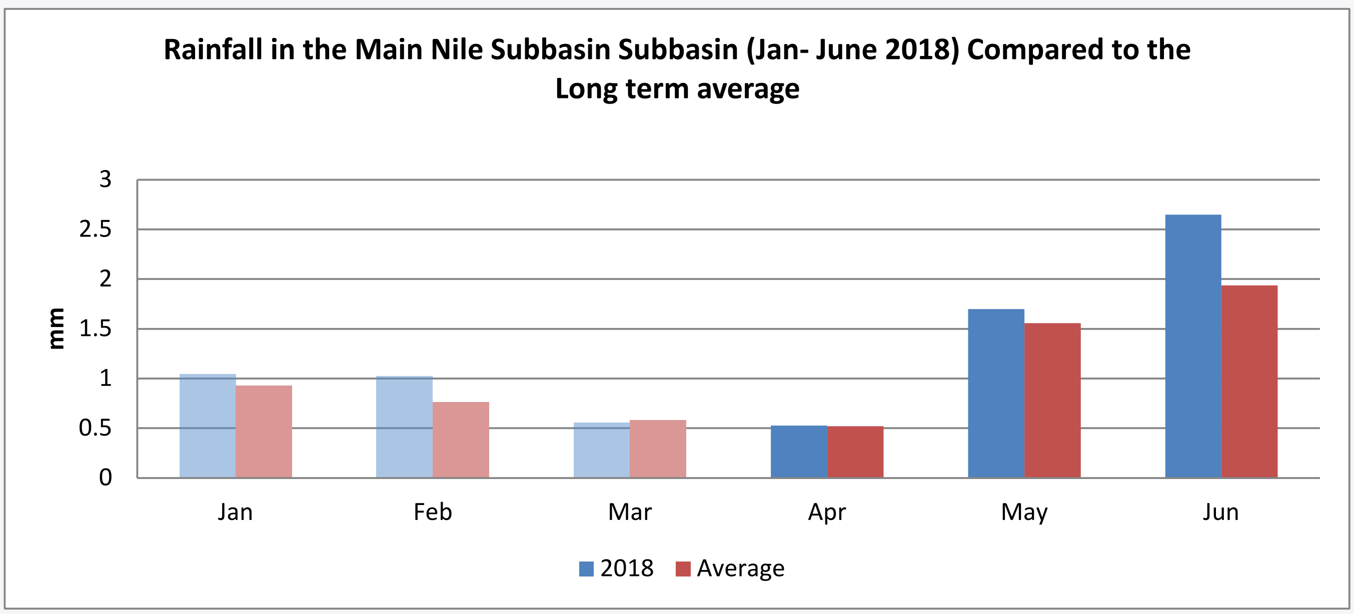
RAINFALL OVER TEKEZE ATBARA SUBBASIN

The Tekeze Atbara subbasin is shared by Ethiopia and Sudan and normally experiences monomodal rain. Monthly rainfall shows an increase as the subbasin starts to experience the rain season with the highest record in June of 86mm which is higher than the long term average by 37%. however less rainfall was recorded in May compared to the long term average as shown below.



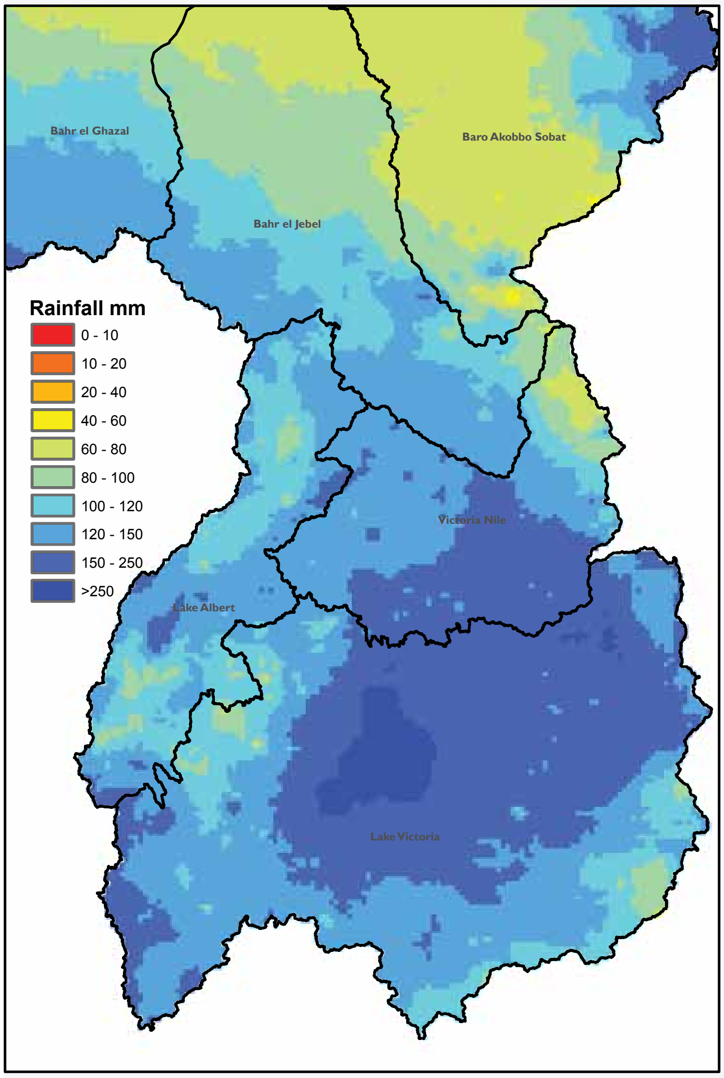
RAINFALL OVER MAIN NILE SUBBASIN

The Main Nile subbasin experiences the driest climate over the entire Nile Basin with very little rainfall amounts recorded mainly in July and August. The Delta region which is close to the Mediterranean Sea exhibits more rainfall. Monthly rainfall from April to June 2018 over the Main Nile subbasin records very little rainfall of less than 5mm .

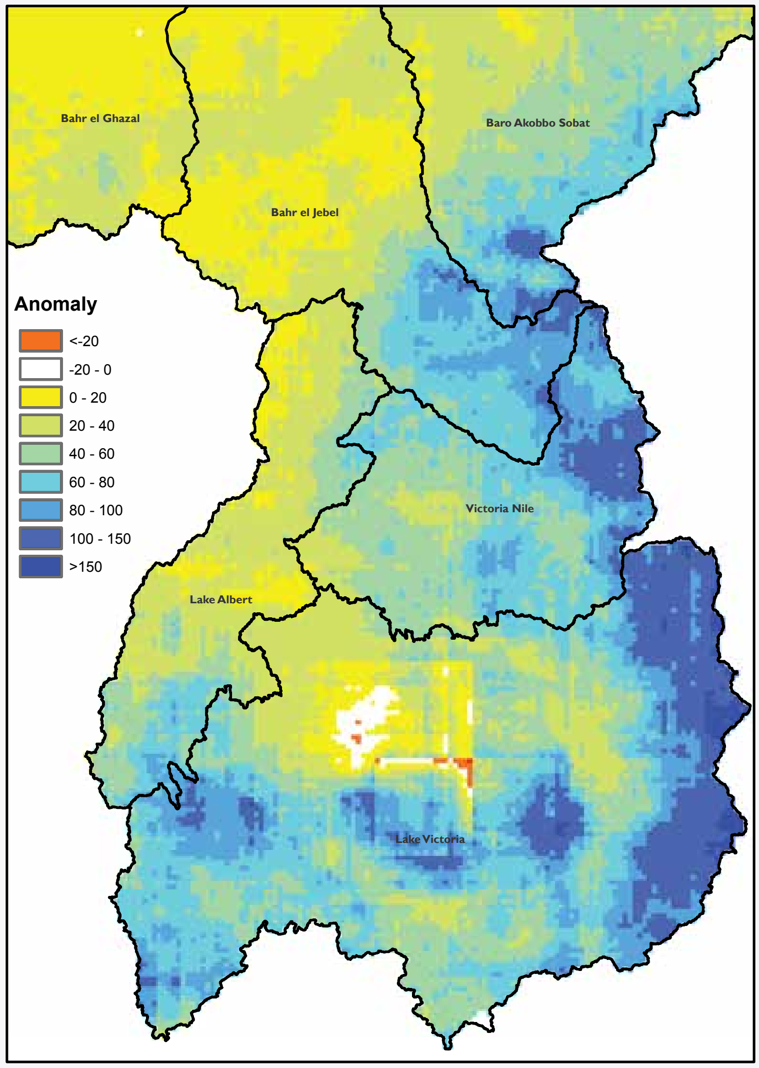


SEASONAL RAINFALL IN THE EQUATORIAL LAKES REGION

Seasonality in the Nile basin region is determined by the position of the Inter tropical convergence Zone (ITCZ) with moisture sources from the Indian and Atlantic oceans. The Nile Equatorial Lakes region experiences the first wet season of the year during March- April - May. In 2018, during the MAM season, rainfall was detected in some parts of the Lake Victoria subbasin , parts of Victoria Nile , southern part of the Bahr el Ghazal, southern part of Bahr el Jebel and parts of the Baro Akobo Sobat subbasins higher than the long term average.



Average Rainfall, March to May, 1985 -2015 , CHIRPS v 2.0

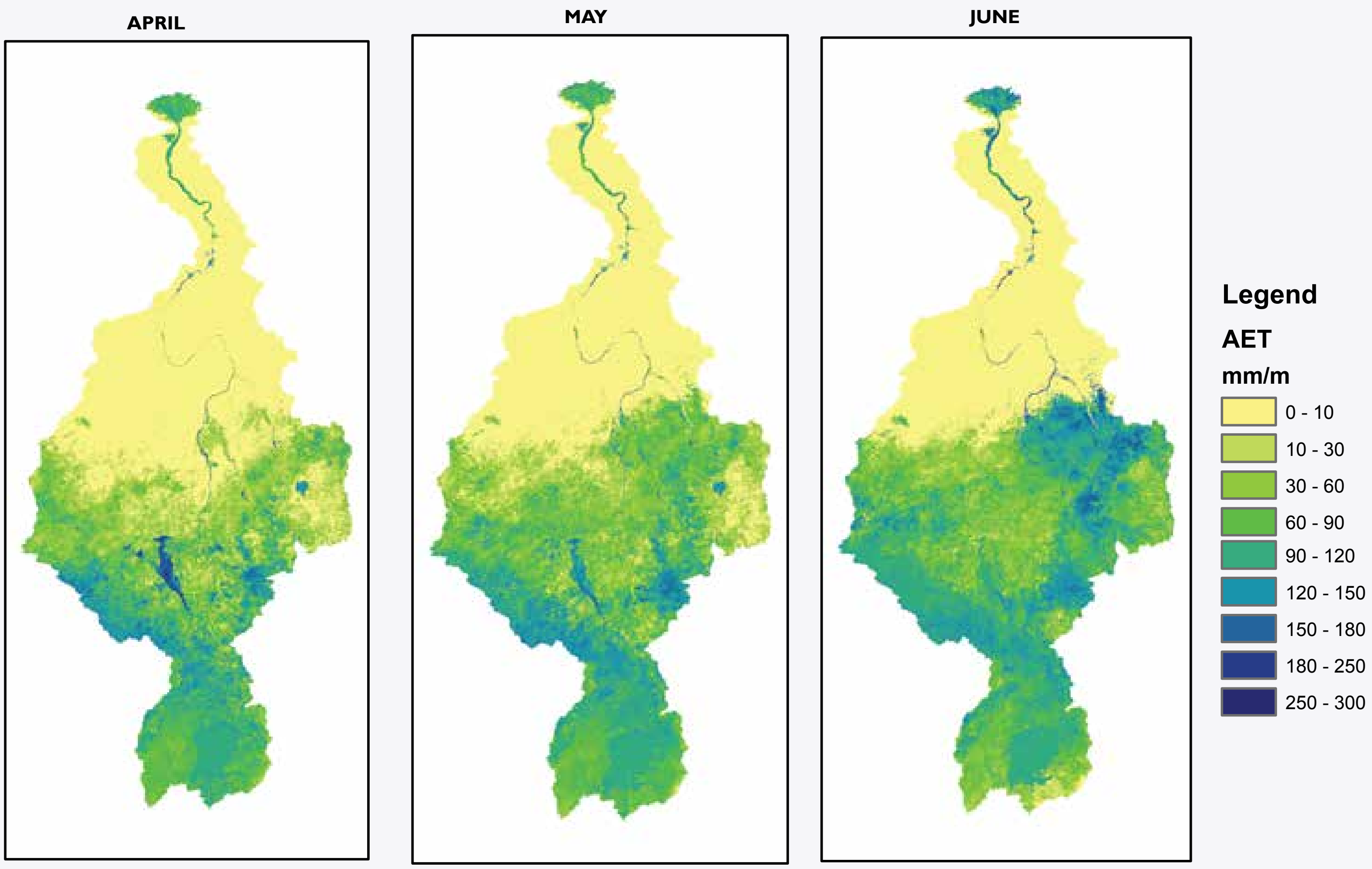


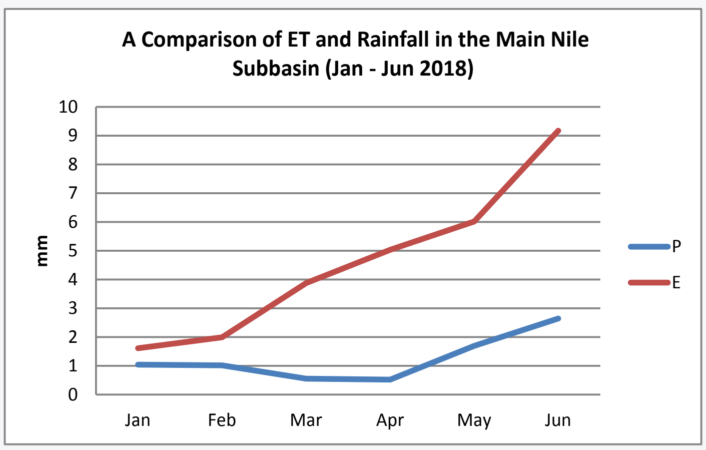
2018 March to May Season Anomaly, CHIRPS v 2.0

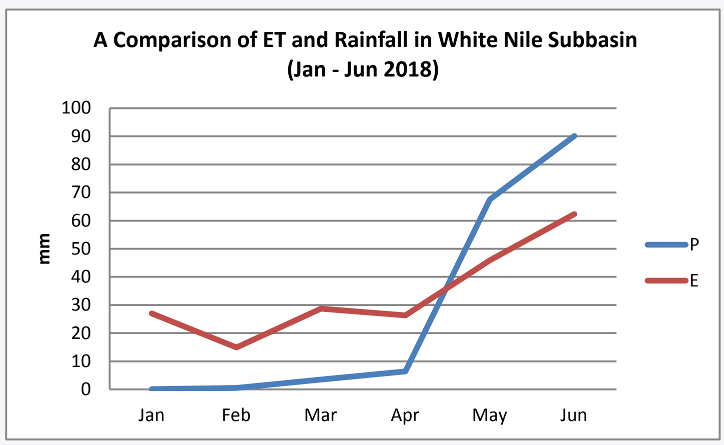
ACTUAL EVAPOTRANSPIRATION OVER THE NILE BASIN

Actual Evapotranspiration is a major component of the water balance of the Nile basin. Monitoring monthly AET is based on data from FEWSNET early warning and drought monitoring data portal for April to June 2018 and the analysis is shown below.

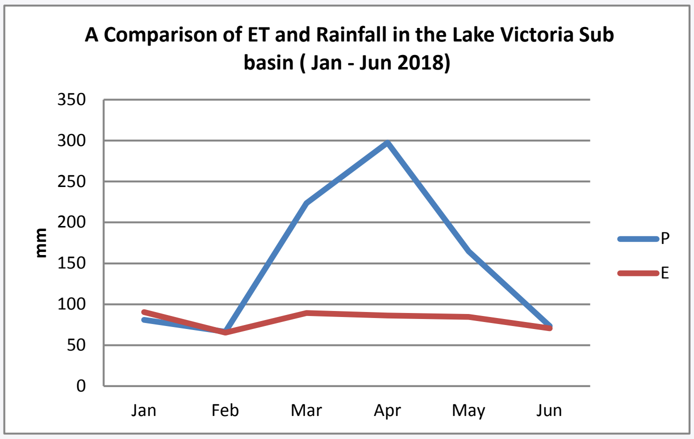
Monthly Actual Evapotranspiration over the Nile Basin April to June 2018

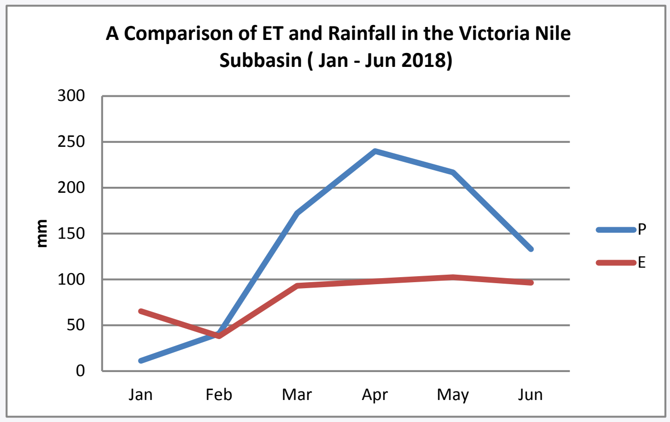


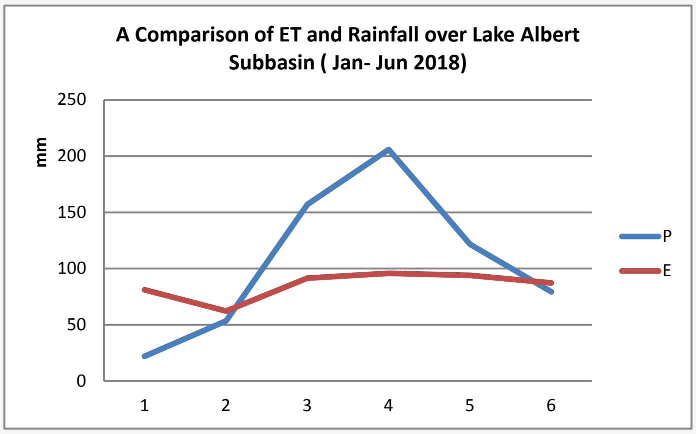


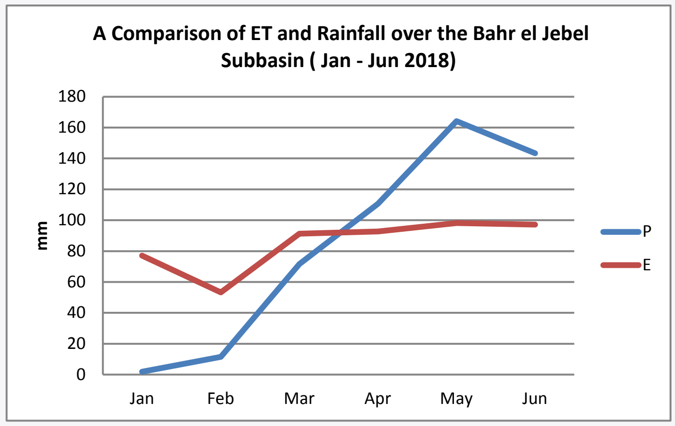


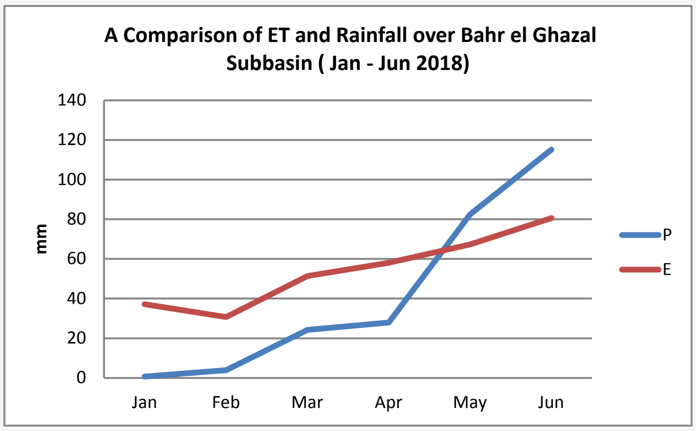
Estimation of Monthly Actual Evapotranspiration Jan - Jun 2018

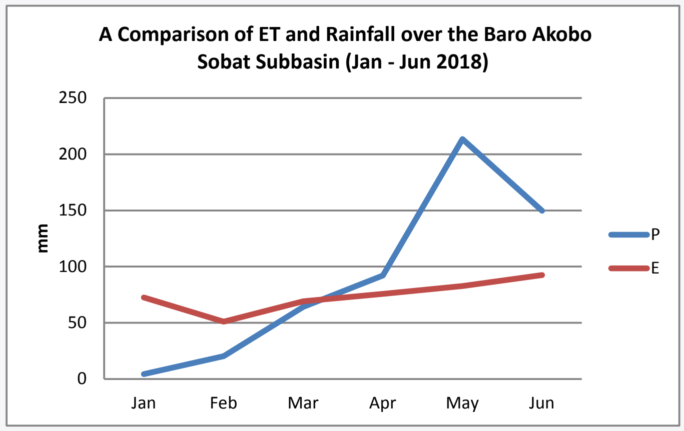


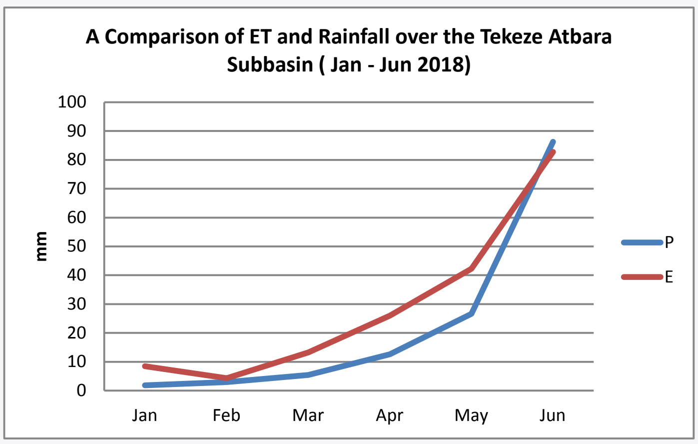








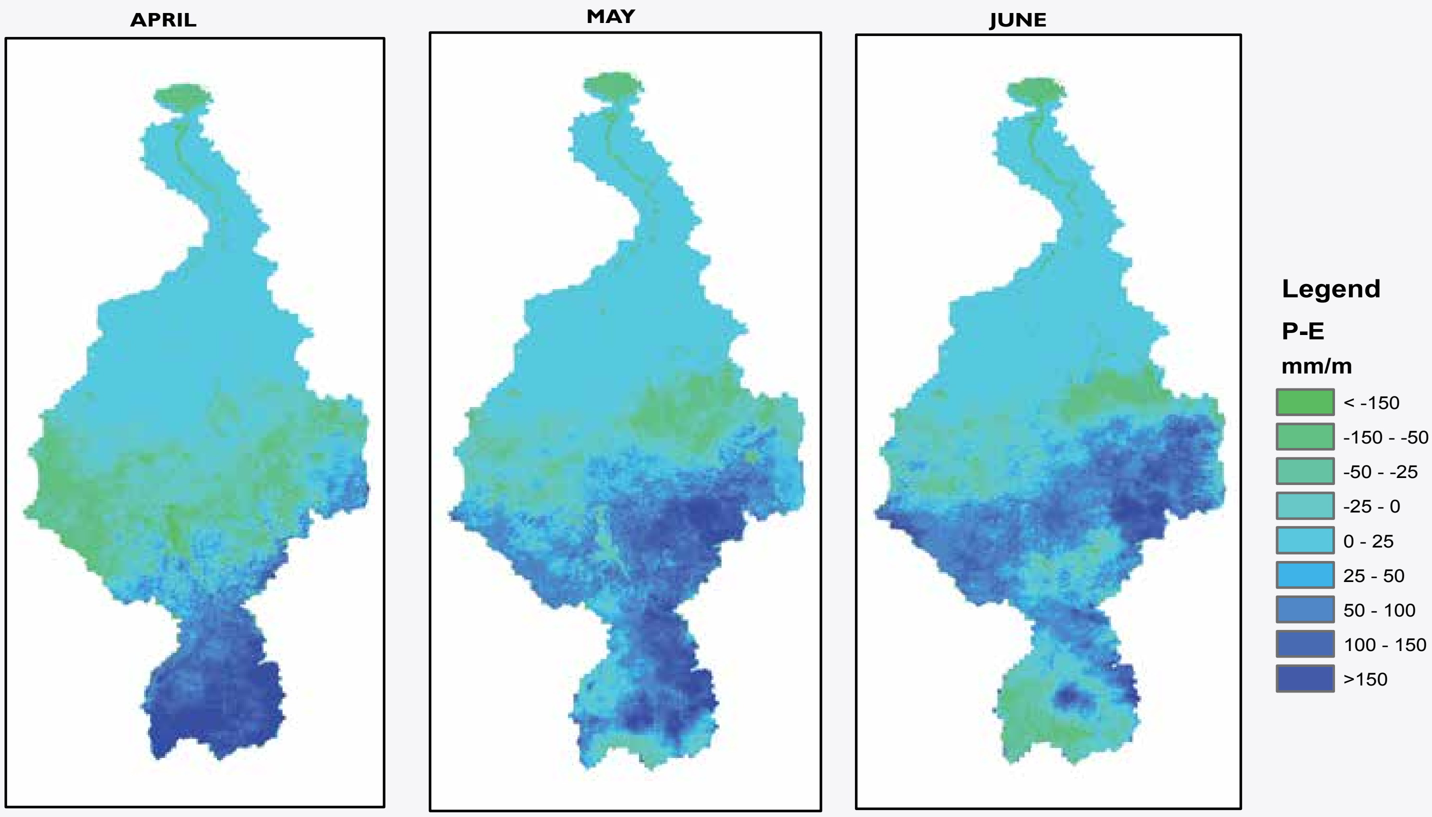




Runoff

Runoff is estimated as total precipitation less the losses caused by evapotranspiration (loss to the atmosphere from soil surfaces and plant leaves). Rainwater that is not evaporated or stored in the soil eventually runs off the surface and finds its way into rivers, streams, and lakes or recharges ground water. The difference of P-ET gives an indication of such beneficial or non beneficial losses. This serves to identify, locate or delimit regions that suffer from a deficit of available water, a condition that can severely affect the effective use of the land for such activities as agriculture or stock-farming.

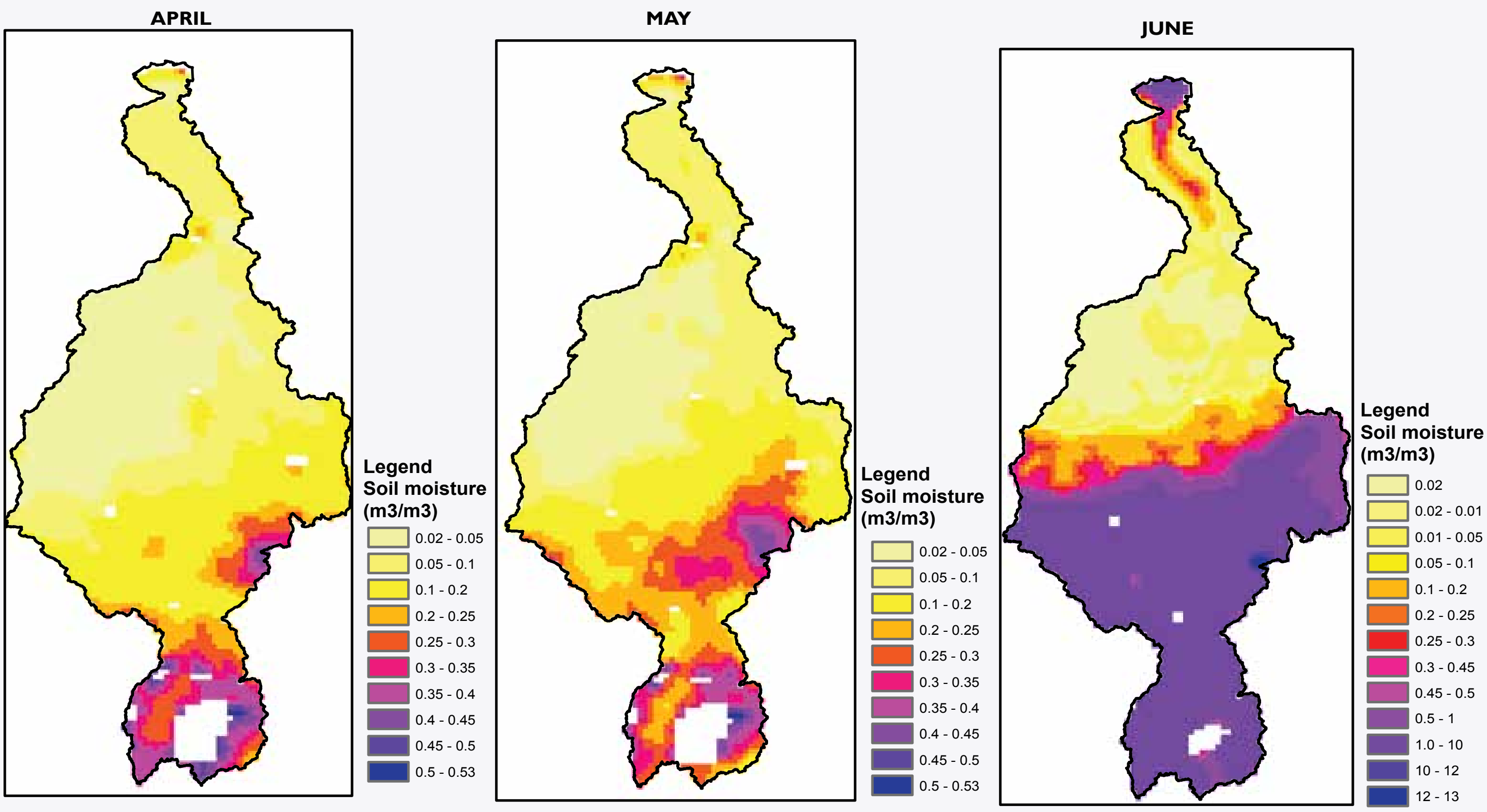
In 2018, there is rainfall excess observed during the month of April in the Equatorial lakes region which extends to the Eastern Nile region in May and June as the wet season starts.



Soil Moisture Variation April- June 2018

NASA's Soil Moisture Active Passive Mission (SMAP) measures soil moisture from space in the root zone (about 5cm). Soil moisture is a key control on evaporation and transpiration at the land-atmosphere boundary. Since large amounts of energy are required to vaporize water, soil control on evaporation and transpiration also has a significant impact on the surface energy fluxes. Soil moisture strongly affects plant growth and hence agricultural productivity, especially during conditions of water shortage and drought. SMAP provides information on water availability and environmental stress for estimating plant productivity and potential yield and for famine aerly warning.

During April to June 2018, soil moisture is detected to increase towards June especially in the Equatorial lakes region- as depicted by the Rainfall excess (P-E) maps. This is an indication of availability of water for runoff.



Soil Moisture SMAP- 3 day composite

Water levels in major lakes in the River Nile Basin region basing on Satellite Altimetry

The River Nile and Lakes with in the Nile Basin region are extremely sensitive to changes in rainfall with variations impacting lake levels and river discharges.

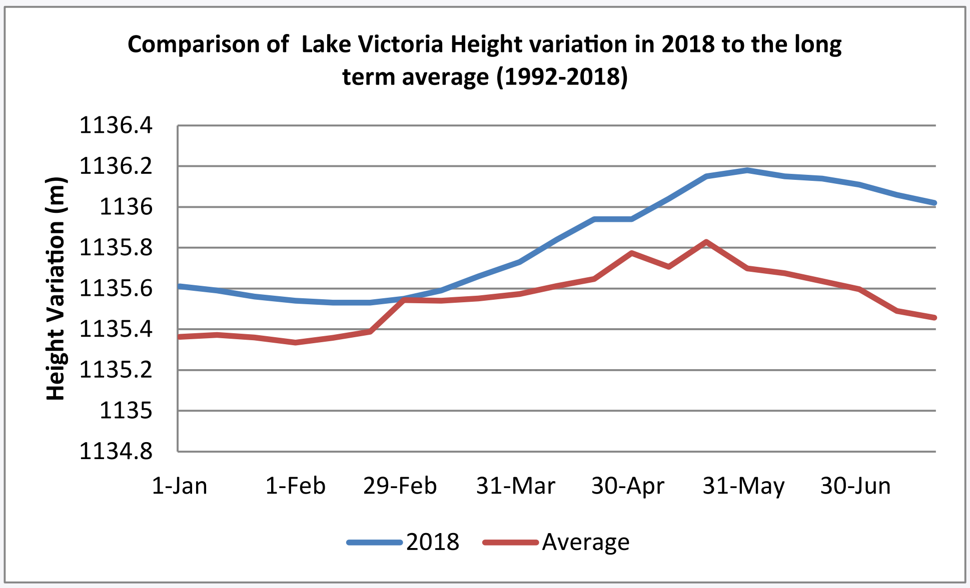
The major lakes in the Nile basin system are Lake Victoria, Lake Kyoga, Lake Albert, Lake Tana, Lake Edward, and Lake Nasser. Numerous tributary rivers flow into the upper lakes and it is essential to monitor these differences in water levels.

Relative lake height variations have been computed from TOPEX/POSEIDON (T/P), Jason-1 and Jason-2/OSTM altimetry with respect to a 9 year mean level derived from T/P altimeter observations for some of the lakes in the Nile Basin. The height variation time series has been smoothed with a median type filter to eliminate outliers and reduce high frequency noise.

Data source is USDA/NASA/SGT/UMD

Lake Victoria Water Levels

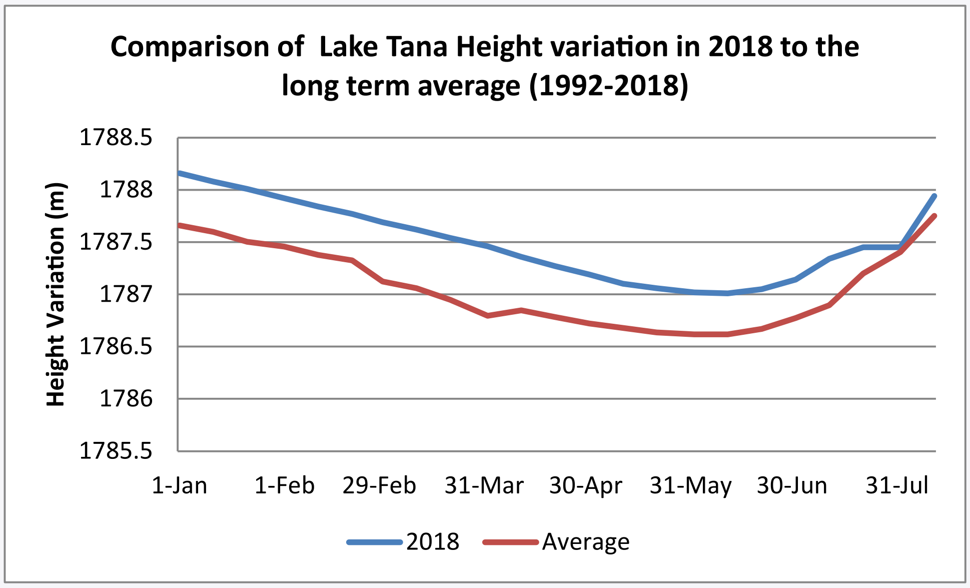
TPJOJ.2.3 : Data Processing Version ID
314 Victoria_1 : Lake database id number and name
-0.670 33.546 : Latitude and longitude (degrees East) of lake mid-point
-1.335 -0.019 : Latitude range of pass traversing lake at which data is accepted



Lake Tana Water Levels

TPJOJ.2.3 : Data Processing Version ID
402 Tana : Lake database id number and name
12.117 37.404 : Latitude and longitude (degrees East) of lake mid-point
11.950 12.199 : Latitude range of pass traversing lake at which data is accepted

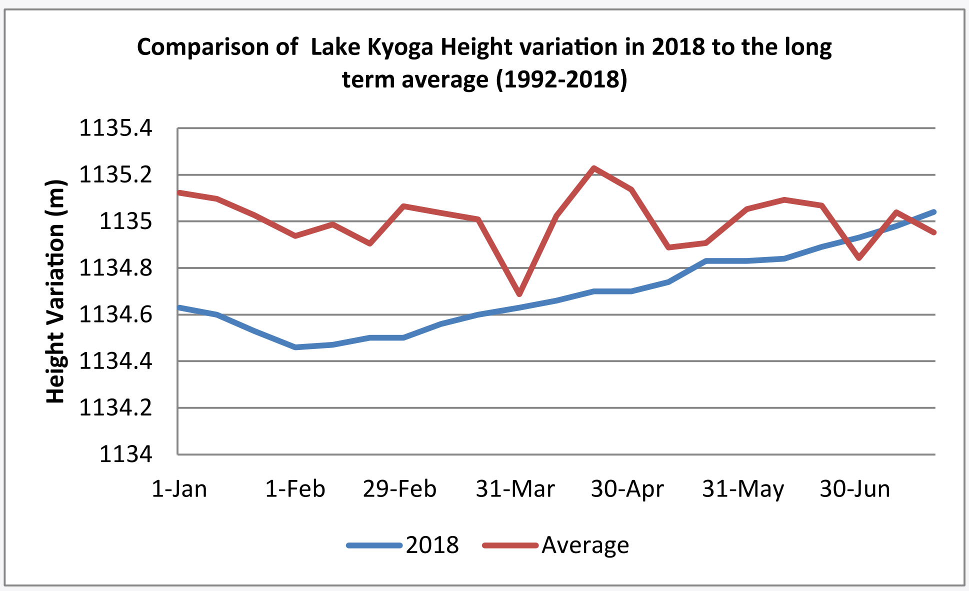
The level of Lake Tana in Ethiopia, fluctuates annually and seasonally following the patterns of changes in precipitation. With a mean depth of 8 only meters, the alternating dry and rainy seasons result in an average difference of 1.5 to 2 meters between the lowest (May-June) and highest (October-November) lake levels.



Lake Kyoga water levels

TPJOJ.2.3 : Data Processing Version ID
398 Kyoga : Lake database id number and name
1.488 32.777 : Latitude and longitude (degrees East) of lake mid-point
1.418 1.551 : Latitude range of pass traversing lake at which data is accepted

Lake Kyoga is a large shallow lake located in central Uganda north of Lake Victoria. The lake has fingerlike extensions with a surface of 1,720 sq. km at an elevation of about 1033m above sea level. Its average depth reaches 3 m, its maximum depth is 5.7 m.



IMPLICATION FOR WATER RESOURCES MANAGEMENT

River basin management is a complex task. It involves several inter-dependent courses and processes. Sound transboundary water resources planning requires reliable data and information on the system features, characteristics and status. While the expertise of the professional water resources planners is essential, solid understanding of the system and governing phenomena plays an equally important role. This underscores the high importance of existing comprehensive data and information within the context of river basin management.

The process entails water resources availability assessment, water demands estimates, and a suite of planning options and alternatives for the entire river basin. Environmental, social, economic and other dimensions have to be appropriately considered. Hydro-meteorological monitoring systems are the most accurate source of real-time data and information. However, due to the fact that – for many technical, economic, and institutional reasons – parts of the Nile Basin are not sufficiently covered by hydromet networks, earth observations represent a viable source of information that well inform basin water resources planning and development.

Monitoring the Nile Basin using satellite observation provides key information on water availability and spatial and temporal distribution of rainfall over the Nile basin can be therefore determined. Seasonality in the Nile basin region, long-term variation for each sub-basin, and actual evapotranspiration could thus be estimated. Water levels in major lakes wetlands extent, and soil moisture as well as some water quality parameters can be defined.

The detected variations in the distribution of rainfall in the March- April- May 2018 wet season above the long term average in the Nile Equatorial lakes region may result in greater crop harvests beyond the regions demand compared to the other Nile Basin regions which were dry during this season. This presents an opportunity for inter-basin agricultural trade to meet food deficiets in parts of the Nile Basin experiencing drought conditions.
Also, variation of evapo-transpiration rates with in the basin presents an opportunity for wise allocation of water conservation projects and increased storage in the basin.

The Nile Basin Initiative continues to collect, analyse and share remotely sensed data and information on Nile Basin hydrology to identify such opportunities for regional integration and cooperation.

NILE BASIN INITIATIVE
INITIATIVE DU BASSIN DU NIL

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#NileCooperation; #NileBasin; #OneNile

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